

**DRAFT FINAL
EXPANDED ENGINEERING EVALUATION/COST ANALYSIS (EEE/CA)
FOR THE
McLAREN TAILINGS SITE
COOKE CITY, MONTANA**

Engineering Services Agreement DEQ/MWCB 401027
Task Order Number 05

Prepared for:

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TABLE 5-1
McLAREN TAILINGS SITE
RISK-BASED CONCENTRATIONS FOR CONTAMINANTS OF CONCERN
FOR THE RESIDENTIAL SCENARIO (SMITH, 19999)

Contaminant of Concern	Residential Soil Ingestion (soil conc.) mg/Kg	Residential Dust Inhalation (soil conc.) mg/Kg	Residential Water Ingestion µg/L
Cadmium	39	140,000 920 (Carc.)	18
Copper	3,100	NA	1,500
Iron	23,000	NA	11,000
Mercury	23	7	11
Silver	390	NA	180

NA = Not Applicable, concentration is more than unity.

Carc = Carcinogenic RBC

mg/Kg = milograms per Kilograms

µg/L = micrograms per Liter

TABLE 5-2
McLAREN TAILINGS SITE
SITE RISK-BASED CONCENTRATIONS FOR CONTAMINANTS OF CONCERN FOR
THE RECREATIONAL SCENARIO (TETRA TECH, 1996)

Contaminant of Concern	Recreational Soil Ing./Inh. mg/Kg	Recreational Water Ingestion µg/L
Cadmium	1,750 22 (Carc.)	256
Copper	54,200	18,900
Iron	NA	NA
Mercury	440	153
Silver	NA	NA

NA = Not Applicable, concentration is more than unity.

Carc. = Carcinogenic

mg/Kg = milograms per Kilograms

µg/L = micrograms per Liter

5.1.4 Risk Characterization

Residential Land Use Scenario

The residential exposure assumptions utilized to estimate contaminant intakes were compared to the risk-based concentrations (RBCs) on Table 5-1. These data were used to calculate resultant human health non-carcinogenic HQs and carcinogenic risk values for each COC. The results of the risk calculations for the residential land use scenario at the McLaren Tailings Site are summarized on Table 5-3.

TABLE 5-3
McLAREN TAILINGS SITE
SUMMARY OF NON-CARCINOGENIC HAZARD QUOTIENTS (HQs)
AND CARCINOGENIC RISK VALUES FOR THE
RESIDENTIAL LAND USE SCENARIO

Non-Carcinogenic HQ Summary	Soil Ingestion	Water Ingestion	Dust Inhalation	Total
Cadmium	0.4205	0.0714	0.0001	0.4920
Copper	2.4516	0.0021	0.0076	2.4613
Iron	11.6087	8.7455	0.2670	20.6212
Mercury	0.0083	0.0200	0.0271	0.0554
Silver	0.0787	0.0000	0.0000	0.0787
Total HQ - Non- Carcinogenic	14.5678	0.3019	0.3019	23.7086
Carcinogenic Risk Summary				
Cadmium	NC	NC	1.78E-08	1.78E-08
Total Risk - Carcinogenic	NC	NC	1.78E-08	1.78E-08

NC = Not Calculated because no RBC is provided.

HQ values exceed 1.0 for the residential land use scenario for two COCs (Cu and Fe) via two exposure pathways. HQ values greater than 1.0 indicate the potential for harmful effects by a COC via the specified pathway. Soil ingestion of Cu and Fe, and water ingestion of Fe comprise the majority of the potential residential risk at the site.

The lower part of Table 5-3, carcinogenic risk, indicates that the residential exposure to COCs (only Cd has carcinogenic RBCs) at the site results in a total carcinogenic risk of 1.78E-08, which does not exceed one per million (1.00E-06) exposed individuals. The EPA utilizes a 1.00E-06 value as a point of departure in assessing the need for contaminant clean up at a particular site.

Recreational Land Use Scenario

The recreational exposure assumptions utilized to estimate contaminant intakes were compared

to the risk-based concentrations on Table 5-2. These data were used to calculate resultant human health carcinogenic risk values and non-carcinogenic HQs for each COC. The results of the risk calculations for the recreational land use scenario at the McLaren Tailings Site are summarized on Table 5-4.

TABLE 5-4
McLAREN TAILINGS SITE
SUMMARY OF NON-CARCINOGENIC HAZARD QUOTIENTS (HQ)
AND CARCINOGENIC RISK VALUES FOR THE
RECREATIONAL LAND USE SCENARIO

Non-Carcinogenic HQ Summary	Soil Ingestion/ Dust Inhalation	Water Ingestion	Total
Cadmium	0.0090	0.0006	0.0096
Copper	0.1402	0.0001	0.1403
Iron	0.2670	0.0028	0.2698
Mercury	0.0003	0.0003	0.0005
Silver	0.0000	0.0000	0.0000
Total HQ - Non-Carcinogenic	0.4165	0.0037	0.4203
Carcinogenic Risk Summary			
Cadmium	7.31E-07	NC	7.31E-07
Total Risk - Carcinogenic	7.31E-07	NC	7.31E-07

NC = Not Calculated because no RBC is provided.

Inspection of the HQs on Table 5-4 yields the following observations. First, HQ values do not exceed 1.0 for any of the COCs via either exposure route. HQ values greater than 1.0 indicate the potential for harmful effects by a COC via the specified pathway(s). These HQ values indicate a low probability of adverse human health effects for the recreational scenario.

The lower part of Table 5-4, carcinogenic risk, reveals that the recreational exposure to COCs (only Cd has RBCs) at the site results in a total carcinogenic risk of 7.31E-07, which does not exceed one per million (1.00E-06) exposed individuals. The EPA utilizes this 1.00E-06 value as a point of departure in assessing the need for contaminant clean up at a particular site.

5.2 ECOLOGICAL RISK ASSESSMENT

5.2.1 Introduction

The ecological risk assessment was performed for the McLaren Tailings Site following Federal RI/FS guidance for CERCLA (Superfund) sites (EPA, 1988). The key guidance documents used

were EPA's *Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual* (EPA, 1989a), and *Ecological Assessment of Hazardous Waste Sites* (EPA, 1989b). The waste materials present at the site pose a potential risk not only to humans but also to other species that come into contact with them. Due to the sparse and indirect nature of the ecological risk data available for the site, this evaluation is intended as a screening-level ecological risk assessment, and the results are of a qualitative nature.

The ecological risk assessment estimates the effects of taking "No Action" at the site and involves four steps: 1) identification of contaminants and ecological receptors of concern; 2) exposure assessment; 3) ecological effects assessment; and 4) risk characterization. These four tasks are accomplished by evaluating available data and selecting contaminants, species and exposure routes of concern, estimating exposure point concentrations and intakes, assessing ecological toxicity of the COCs, and characterizing overall risk by integrating the results of the toxicity and exposure assessments.

Problems at the McLaren Tailings Site that could impact ecological receptors include elevated concentrations of metals and As in waste materials, and elevated concentrations of metals and As in surface water and stream sediments. The easily accessible waste materials may result in significant ecological effects; the objective of this ecological risk assessment is to estimate current and future effects of implementing the No Action Alternative at the site.

5.2.2 Contaminants and Receptors of Concern

Arsenic in the human health risk assessment, contaminants that are significantly above background concentrations and are associated with the site are retained as COCs. Five of the 13 metals analyzed are present at the site at concentrations significantly above background levels, with 20 percent of the samples detected above the corresponding detection limit: Cd, Cu, Fe, Hg, and Ag. These contaminants are selected for evaluation because they are present in significant concentrations in wastes, stream sediments, and surface water. However, several of these contaminants have no ecological toxicity data with which to evaluate potential effects.

Two groups of ecological receptors have been identified as potentially affected by site contamination. The first group of receptors are those associated with Soda Butte Creek adjacent to and downstream from the site, and includes fisheries, aquatic life, and wetlands. Wetlands of any size are of concern because they typically support a diverse ecological community. These surface water receptors are evaluated using the EPA aquatic life criteria, which apply to aquatic organisms only; there are no criteria with which to evaluate wetlands.

The second group of receptors are native terrestrial plant communities, which are notably absent on many of the wastes at the site. They are of concern because native vegetation has not become established on the wastes, which would help reduce the potential for release of wastes into surface water and reduce exposure to the wastes by human and wildlife receptors.

5.2.3 Exposure Assessment

The two exposure scenarios can be semi-quantitatively assessed. Both the surface water-aquatic

life and plant phytotoxicity scenarios can be compared directly to toxicity standards that apply to the respective environmental media.

Surface Water/Sediment - Aquatic Life Scenario

There are three exposure pathways in this scenario: direct exposure of aquatic organisms to surface water concentrations that exceed toxicity thresholds; ingestion of aquatic species (i.e., insects) that have bioaccumulated contaminants to the extent that they are toxic to the predator (i.e., fish); and exposure of aquatic organisms (i.e., fish embryos) to sediment pore water environments that are toxic due to elevated contaminant concentrations in the sediments. Data used for this assessment were collected in Soda Butte Creek (sediment and surface water) during 2000. Selected water quality and sediment concentration data are presented on Table 5-5.

TABLE 5-5
McLAREN TAILINGS SITE
DOWNSTREAM CONTAMINANT CONCENTRATIONS IN SURFACE WATER (µg/L)
AND STREAM SEDIMENT (mg/Kg)

	Cd	Cu	Fe	Hg	Ag
Surface Water –Soda Butte Creek	0.15	<2.0	2,820	<0.08	<0.63
Stream Sediment –Soda Butte Creek	2.9	207	27,500	0.015	1.1

mg/Kg = milograms per Kilograms

µg/L = micrograms per Liter

Plant - Phytotoxicity Scenario

This scenario involves the limited ability of various plant species to grow in soils or wastes with high concentrations of site-related contaminants. Table 5-6 summarizes concentrations measured in waste materials on-site.

TABLE 5-6
McLAREN TAILINGS SITE
AVERAGE CONCENTRATIONS (mg/Kg) IN SURFACE SOURCES

	Cd	Cu	Fe	Hg	Ag
Background Average	1.7	57.3	27,033	0.04	0.99
Source Surface Maximum	16.4	7,600	267,000	0.19	30.7

mg/Kg = milograms per Kilograms

5.2.4 Ecological Effects Assessment

The known effects of the site COCs are available from several literature sources and are not repeated here. No site-specific toxicity tests were performed to support the ecological risk assessment, either *in-situ* or at a laboratory. Only existing and proposed toxicity-based criteria and standards were used for this ecological effects assessment.

Surface Water/Sediment - Aquatic Life Scenario

Freshwater acute (1-hour average) water quality criteria have been promulgated by the EPA for many of the COCs. Several of these criteria are calculated as a function of water hardness and a few are numerical standards. The numerical water quality standards are presented on Table 5-7 and apply to surface waters downstream from the site. Those criteria that are a function of hardness have been calculated for the downstream station and are presented on Table 5-8.

TABLE 5-7
McLAREN TAILINGS SITE
NUMERICAL WATER QUALITY CRITERIA

Acute Criteria in µg/L	Hg
Soda Butte Creek	1.7

µg/L = micrograms per Liter

TABLE 5-8
McLAREN TAILINGS SITE
HARDNESS-DEPENDENT WATER QUALITY CRITERIA

Acute Criteria µg/L	Cd	Cu	Ag
Soda Butte Creek	7.5	21.4	8.8

µg/L = micrograms per Liter

Presently, the EPA has not finalized sediment quality criteria. Proposed sediment criteria for metals currently consist of the Effect Range - Low (ER-L) and Effect Range - Median (ER-M) values generated from the pool of national freshwater and marine sediment toxicity information (Long and Morgan, 1991). The ER-M values are probably most appropriate to use for comparison to Soda Butte Creek sediment data, and are presented on Table 5-9.

TABLE 5-9
McLAREN TAILINGS SITE
SEDIMENT QUALITY CRITERIA (PROPOSED)

Criteria in mg/Kg	Cd	Cu
Effect Range - Median (ER-M)	9	39

mg/Kg = milograms per Kilograms

Plant - Phytotoxicity Scenario

Information is available on the phytotoxicity for some of the COCs (Kabata-Pendias and Pendias, 1989) and these are listed on Table 5-10. The availability of contaminants to plants and the potential for plant toxicity depends on many factors including soil pH, soil texture, nutrients, and plant species.

TABLE 5-10
McLAREN TAILINGS SITE
SUMMARY OF PHYTOTOXIC SOIL CONCENTRATIONS

	Cd	Cu
Concentration Range (mg/Kg, dry wt.)	3-8	60-125

mg/Kg = milograms per Kilograms

5.2.5 Risk Characterization

This section combines the ecological exposure estimates and concentrations presented in Section 5.2.3 and the ecological effects data presented in Section 5.2.4 to provide a screening level estimate of potential adverse ecological impacts for the scenarios evaluated. This was accomplished by generating ecological impact quotients (EQs), analogous to the human health HQs calculated for human exposures to non-carcinogens. The COC-specific EQs were generated by dividing the particular intake estimate or concentration by available ecological effect values or concentrations. As with the HQs, if EQs are less than 1.0, adverse ecological impacts are not expected at the McLaren Tailings Site.

Surface Water/Sediment - Aquatic Life Scenario

For this scenario, surface water concentration data are compared to acute aquatic life criteria. Limitations of this comparison include the EPA water quality criteria that are not species-specific toxicity levels. They represent toxicity to the most sensitive species, which may or may not be present at the McLaren Tailings Site, and toxicity to the most sensitive species may not in itself be a limiting factor for the maintenance of a healthy, viable fishery and/or other aquatic organisms. The results of the EQ calculations for this scenario are presented on Table 5-11.

TABLE 5-11
McLAREN TAILINGS SITE
ECOLOGIC IMPACT QUOTIENTS (EQs) FOR THE
SURFACE WATER - AQUATIC LIFE SCENARIO

	Cd	Cu	Fe	Hg	Ag
Soda Butte Creek	0.020	0.047	NC	0.024	0.036

NC = Not Calculated because no applicable standard exists.

Examination of Table 5-11 indicates EQ values are all below 1.0; therefore, there are no acute aquatic life impacts in Soda Butte Creek via surface water.

Similarly, stream sediment concentration data are compared to proposed sediment quality criteria (ER-M). Limitations of this comparison include that these sediment quality criteria are preliminary and are also not species-specific. They represent sediment toxicity to the most

sensitive species, which may or may not be present at the McLaren Tailings Site, and toxicity to the most sensitive species may not in itself be a limiting factor for the maintenance of a healthy, viable fishery and/or other aquatic organisms. The results of these EQ calculations are presented on Table 5-12.

TABLE 5-12
McLAREN TAILINGS SITE
ECOLOGIC IMPACT QUOTIENTS (EQs) FOR THE
SEDIMENT - AQUATIC LIFE SCENARIO

Location	Cd	Cu	Fe	Hg	Ag
Soda Butte Creek	0.322	0.531	NC	NC	NC

NC = Not Calculated because no applicable standard exists.

The EQs presented on Table 5-12 indicate no potential for aquatic life impacts (EQs greater than 1.0 are due to apparent sediment toxicity for the COCs in Soda Butte Creek).

Plant - Phytotoxicity Scenario

Source area average concentrations collected at the McLaren Tailings Site are compared to high values of the range of plant phytotoxicity derived from the literature. Limitations of this comparison include that the phytotoxicity ranges are not species-specific; they represent toxicity to species which may or may not be present at the site. Additionally, other physical characteristics of the waste materials may create microenvironments which limit growth and survival of terrestrial plants directly or in combination with substrate toxicity. Waste materials are likely to have poor water holding capacity, low organic content, limited nutrients, and may harden enough to resist root penetration. The results of the EQ calculations for this scenario are presented on Table 5-13.

TABLE 5-13
McLAREN TAILINGS SITE
ECOLOGIC IMPACT QUOTIENTS (EQs) FOR THE
PLANT - PHYTOXICITY SCENARIO

	Cd	Cu	Fe	Hg	Ag
McLaren Site – Maximum	2.05	60.80	NC	NC	NC

NC = Not Calculated because no applicable standard exists.

The EQs presented on Table 5-13 indicate the potential for adverse ecological impacts to plant communities for the McLaren Tailings Site. The calculated EQs greater than 1.0 include: Cd and Cu. The non-conservative assumption of using the high end of the phytotoxicity range to derive these EQs, probably underestimates the potential phytotoxic effect to the plant community. However, several other factors in addition to phytotoxicity combine to adversely affect plant establishment and success on the waste materials.

5.2.6 Risk Characterization Summary

The calculated EQs can be used to assess whether ecological receptors are exposed to potentially harmful concentrations of site-related contaminants via the three ecological scenarios evaluated. The EQs for each of the three scenarios at the McLaren Tailings Site are presented on Table 5-14 to estimate a combined ecological EQ for each scenario and each contaminant. The results of combining the ecological scenarios are also summarized on Table 5-14.

TABLE 5-14
McLAREN TAILINGS SITE
SUMMARY OF ECOLOGIC IMPACT QUOTIENT (EQ) VALUES

Ecological EQs	Surface Water	Sediment	Plant Toxicity	Total
Cadmium	0.020	0.322	2.05	2.392
Copper	0.047	0.531	60.80	61.378
Iron	NC	NC	NC	NC
Mercury	0.024	NC	NC	0.024
Silver	0.036	NC	NC	0.036
Total EQ	0.126	0.853	62.85	63.829

NC = Not Calculated because no applicable standard exists.

The aquatic life scenario results in EQs as high as 0.05 (surface water - Cu), and 0.5 (sediments - Cu) in Soda Butte Creek. The plant toxicity EQs are as high as 61 (Cu). These EQs show that even at the lower range of these calculated risk estimates, the ecological risk characterization demonstrates that contaminants at the site constitute a possible adverse ecological effect via the plant phytotoxicity scenario and may justify clean up. Copper is the primary ecological COC, and the plant community is the primary receptor; Cd phytotoxicity is a secondary COC.